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Children's Interpretation of Sentences Containing Every

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CHILDREN'S INTERPRETATION OF SENTENCES CONTAINING EVERY

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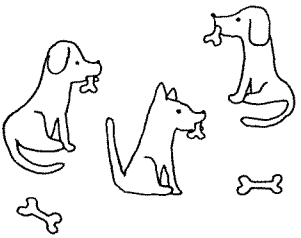
1. Introduction

This paper reports the latest experiment in a series of studies investigating children's interpretation of sentences containing the quantifier "every". The preceding experiments are discussed in Philip & Aurelio (this volume), Philip & Takahashi (this volume), and Takahashi (1990). We first review the main points of these papers to clarify the purposes of the new experiment.

The basic findings that initiated our interest in the subject are described in Philip & Aurelio (this volume) (henceforth P/A): When shown a picture such as the one given below and asked the question, "Is every dog eating a bone?", children often answer "No."

I would like to thank Tom Roeper, Jill de Villiers, Emmon Bach, Stephen Crain, Roger Higgins, Angelika Kratzer, Tom Maxfield, Dana McDaniel, Yutaka Ohno, Bernadette Plunkett, and Bill Philip for valuable comments and suggestions. I am grateful to the teachers and children at Sunnyside Day-care Center for their cooperation with the experiment.

(1) forward spreading:

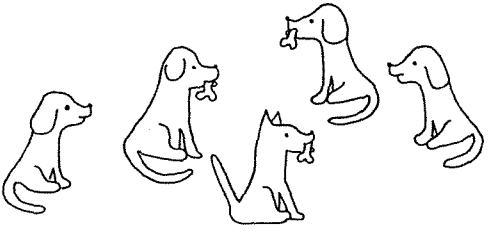


Is every dog eating a bone? (sentence type: E—>A)

When asked "Why not?", they would explain "Because these bones are not being eaten," pointing to the left-over bones. Children's responses indicate that their rejection of the picture is not due to a 'wide-scope reading' of "a bone" (there is one bone which every dog is eating). They are allowing the 'distributive reading', in which the referents of the object NP (bones) are distributed over the referents of the subject NP (dogs). But children still reject the picture, unlike adults. A theory neutral term 'quantifier spreading' was adopted to refer to this phenomenon.

Quantifier spreading also occurs in the opposite direction. So, many children reject the following picture-sentence pair as well:

(2) backward spreading:



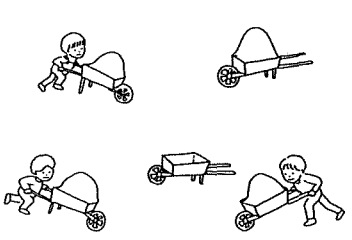
Is a dog eating every bone? (sentence type: A—>E)

Philip & Takahashi (this volume) (henceforth P/T) examines if any linguistic factor plays a role in quantifier spreading. We compared children's responses to two classes of test items which provided comparable extralinguistic stimuli but distinct linguistic stimuli. The experimental task was to evaluate if a

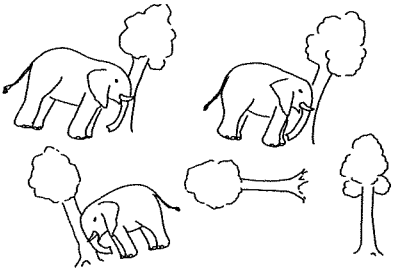
picture 'matched' an accompanying 'story' or not. In one class of items, the main part of the story was a sentence containing both a quantified NP ("every" N) and an indefinite NP ("a" N) (sentential context). In the other, the quantified NP and the indefinite NP were split apart in two sentences (discourse context). The pictures presented with corresponding items in the two classes were of the same pattern, assuring extra-linguistic stimuli to be held constant across the two classes. Examples are given below:

(3) E-->A type:

a. sentential context: b. discourse context:



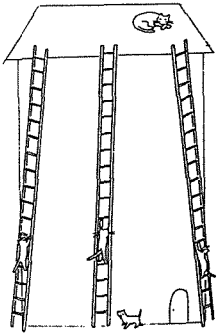
Every boy is pushing a wheelbarrow.



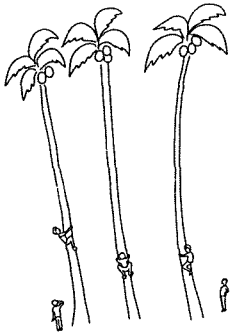
Every elephant is pushing.
A tree is on the ground.

(4) A-->E type:

a. sentential context: b. discourse context:



A cat is climbing every ladder.



A man is climbing.
Every tree is tall.

We found that in the case of the youngest group of children we tested (four-year-olds), spreading occurred more frequently in the sentential context items (over 80%) than in the discourse context items (35%). It was concluded that for this age group at least, some linguistic factor must play a role in quantifier spreading. Because of the close to 35% spreading in the discourse context items, however, we could not rule out the possibility that some extra-linguistic factor was also responsible for spreading observed in this experiment.

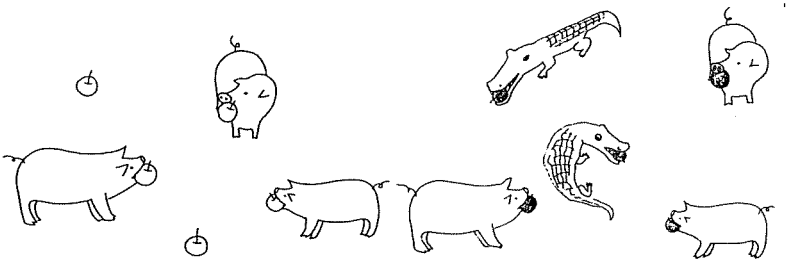
Takahashi (1990) discusses methodological defects in the P/T experiment.[1] In a Japanese 'translation' of this experiment, it was observed that the 'matching' task causes children to fixate on the idea that there should be a one to one match-up between agents and objects in the picture regardless of the type of accompanying texts.

Another potential problem was in the picture. As pointed out by Dana McDaniel (personal communication), the pictures used in the experiment encourage the creation of a 'mental picture' which fails to be an appropriate description of the sentence even under the adult interpretation. When shown a picture such as the one given in (5a.), for instance, it is easy for the children to imagine two additional pigs to which the extra apples belong. If there are five pigs in the children's mind, the accompanying sentence, "Every pig is eating an apple" would trivially be false.

1. The arguments are based on two Japanese experiments. Since the nature of the problems are extralinguistic, they should apply to the English experiments as well.

(5)a. P/T
Japanese Experiment 1

b. Japanese Experiment 2
The New Experiment



Every pig is eating an apple. Is every pig eating an apple?

In the second Japanese experiment, we tried to eliminate these problems by using pictures of the pattern represented in (5b.)[2] and by changing the experimental task to that of answering a simple yes-no question. The result was a drastic improvement in children's performance, almost to a complete exclusion of spreading in E-->A items and in intransitive items. Some spreading, however, was still detected in A-->E items. The conclusions were: (i) even though there may be a linguistic cause for spreading, similar surface effects can easily be triggered by extra-linguistic factors as well, (ii) these extralinguistic interference can be eliminated by the proposed changes in the experimental design, and (iii) there indeed is a linguistic cause for quantifier spreading.

2. The New Experiment

2.1 Purpose

Assuming that there is a linguistic cause for quantifier spreading, the next task is to determine the exact nature of children's linguistic competence responsible for this phenomenon. The new English experiment was designed with this goal in view.

2.2 Method

The new experiment adopts the modifications introduced in the second Japanese experiment reviewed above: The task given to the children is to answer a

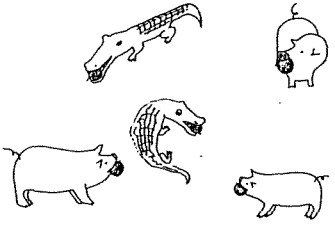
2. This modification of the picture pattern was suggested to me by Stephen Crain (personal communication).

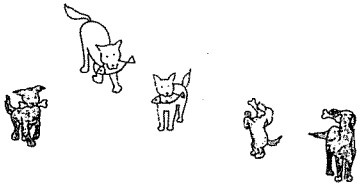
simple yes-no question about each picture shown to them. The pictures are of the type shown in (5b)., in which all the agents are exhaustively linked with some object and all the objects with some agent. These modifications proved to be effective in excluding extralinguistic interference in the English experiment as well.

2.3 Test Items

In order to choose between different possibilities of characterizing children's interpretations of "every", we included a wider range of test items in the new experiment. An important addition was picture-sentence pairs which would be judged false even under the distributive reading in the adult grammar. Both E-->A and A-->E questions, thus, were asked of pictures of the type shown in (6a. and b.).[3]

(6)a. Picture Type 1: b. P2:





T1: Is every pig eating an apple?
T2: Is a pig eating every apple?
T3: Are three pigs eating an apple?

T4: Is every dog holding a bone?
T5: Is a dog holding every bone?
T6: Are three dogs holding a bone?

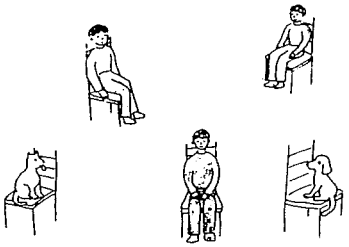
These picture types were also paired with sentences which had "three" instead of "every" in the subject NP, as shown under T3 and T6 above. This was in response to Angelika Kratzer's comment (personal communication) that negative responses to T1 and T5 may merely reflect children's preference for pictures that describe the "simplest possible situation" in which a sentence is true. For example, T1 is true for a picture in which there are just three pigs each eating an apple (cf. P5). (6a.), therefore, may be rejected

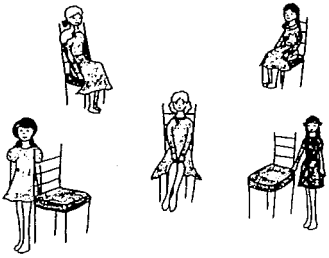
3. The examples given in (6) through (10) represent the types of sentences paired with each picture. They are not always the actual sentences used in the experiment.

as a picture containing 'superfluous' elements. Children who answer in the negative to T1 for this reason should do the same to T3 as well. If the answers to the "three"-questions are in the positive, on the other hand, negative responses to the "every"-questions must receive some other explanation.

We also tested intransitive sentences paired with true and false pictures. Two types of intransitive verbs were used: pseudo-transitive verbs such as "read", and "drive", and pure intransitive verbs such as "sleep", and "sit". Examples with "sit" are given below:

(7)a. P3: b. P4:

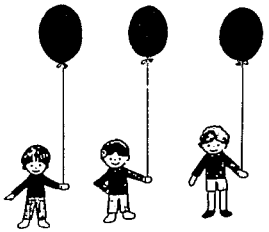


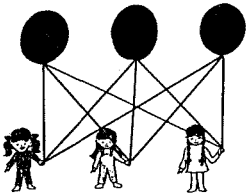


T7: Is every boy sitting? T8: Is every girl sitting?

Another major test item was sentences containing two quantified NPs. They were paired with pictures of the following type:

(8)a. P5: b. P6:

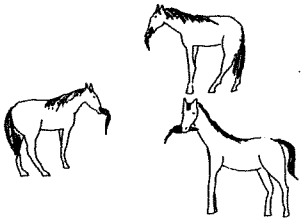




T9: Is every boy holding every B? T10: Is every girl holding every B?

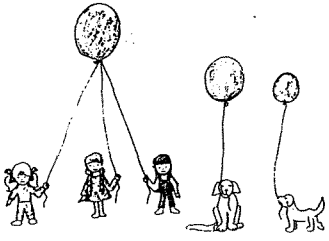
In addition, there were tests for distributive reading (T11 and T12) and non-distributive reading (T13 - T18).

(9) P5:



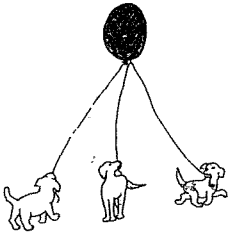
T11: Is every horse eating a carrot?
T12: Is a horse eating every carrot?

(10)a. P7:



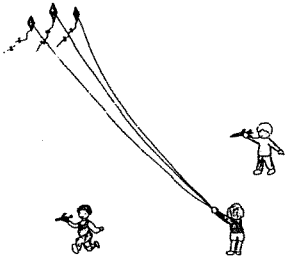
T13: Is every girl holding a B?
T14: Is a girl holding every B?

b. P8:



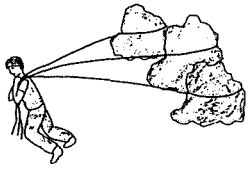
T15: Is every dog holding a B?

(11)a. P9:



T16: Is every boy flying a kite?
T17: Is a boy flying every kite?

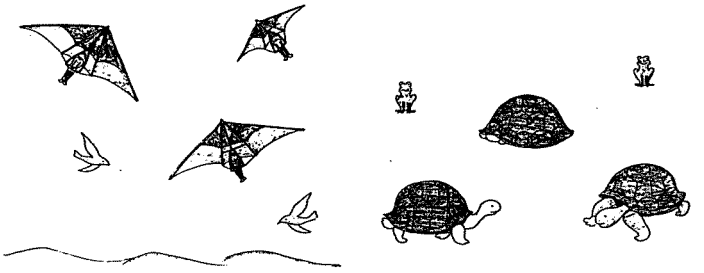
b. P10:



T18: Is a man pulling every rock?

The experiment was conducted in two sessions. Each session consisted of half the number of test items of each type. (See Appendix 1 for the number of trials given to each test item.) At the beginning of each session, children were asked two simple warm-up questions. These questions also served as tests for the comprehension of the basic meaning of "every".

(12)a. b.



WU1: Is every boy flying? WU2: Is every turtle walking?

2.4 Subjects

We tested twenty-two children between three and six years of age. (13) shows the grouping of children in the day-care center where we conducted the experiment. After running the experiment on the older group (Group B), the number and the order of questions were changed slightly to make the experiment easier for the younger children. (See Appendix 2 for the order of questions presented to each group.) Since we find no significant effects of this reorganization, we regard the experiment as essentially equivalent for the two groups and report the results collectively.

(13)

	Group A	Group B	Total
Age 3	3	0	3
4	10	3	13
5	0	1	1
6	0	5	5
Total	13	9	22

2.5 Results

Most of the responses to the questions were in firm "yes"s or "no"s. Some answers, however, were less definite. We used the following criteria in counting

these responses: (i) if the child spontaneously corrects an answer, we count the latter response as the answer given by the child, (ii) if there is some hesitation in the answer but if the response is reasonably quick and there is no correction, we count the answer, (iii) if there is correction as well as hesitation, we exclude the answer from the analysis.

Two of the twenty-two children answered "yes" to all the questions asked of them. They either have not learned the basic meaning of "every" or lack the ability to understand the experimental task.

We set the criterion for passing the "three"-test (T3 and T6) at three or more "yes"s out of four trials. Four children failed the test and were excluded from further analysis. Sixteen children passed the test.

All the sixteen children accepted T9 as well as T10. This indicates, along with their responses to the core test items, that there is something special about their interpretation of "every".

All the children accepted both T11 and T12, indicating that they were capable of using the distributive reading. Whenever the answer to a core test item was in the negative, we asked the reason for the rejection. Children's responses invariably indicated that they were using the distributive reading.[4]

Children's responses to the core test items (T1, T2, T4, T5, and T7) are summarized in (14). As can be seen in this chart, we were able to identify three groups (G1+G2, G3, and G4) whose response patterns were significantly different from each other. A post-hoc t-test confirmed that the groups behaved differently across the five test items ($p < .001$).[5]

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4. A typical explanation for rejecting T1, for instance, was, "Because alligators are eating (an apple), too."

5. An analysis of variance revealed significant differences between groups (F=88.836, P=.0000), as well as between items (F=23.745, P=.0000), and a significant interaction between groups and items (F=3.778, P=.0010).

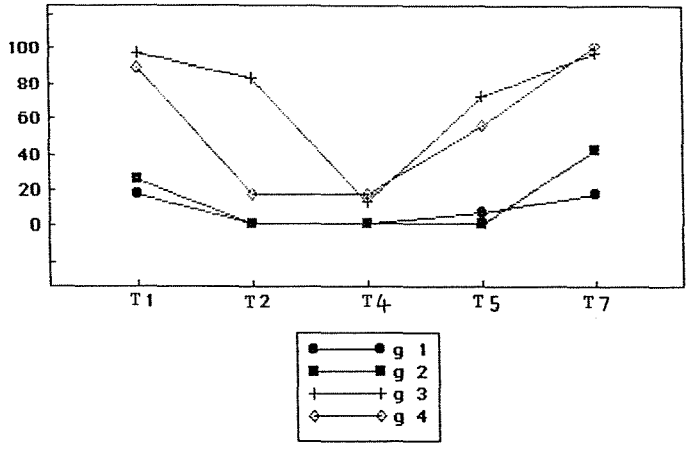
(14) Number of "yes"/"no" responses

Subject(age) \ Test Item	T1 (Y)	T2 (N)	T4 (N)	T5 (Y)	T7 (Y)	T7a.	T7b.
Group 1 A(3)	1/3	0/4	0/4	0/5	1/3	1/1	0/2
B(4)	0/4	0/4	0/4	1/4	0/4	0/2	0/2
C(4)	1/3	0/4	0/3	0/4	1/3	1/1	0/2
AV	17	0	0	7	17	33	0
G2 D(4)	1/3	0/3	0/4	0/6	2/4	2/1	0/3
E(6)	1/3	0/3	0/4	0/6	3/3	3/0	0/3
AV	25	0	0	0	42	83	0
G3 F(4)	4/0	4/0	0/1	4/1	3/1		
G(4)	4/0	4/0	0/4	4/1	4/0		
H(4)	4/0	3/1	0/3	3/2	4/0		
I(4)	4/0	2/1	2/2	3/2	6/0		
J(4)	3/1	2/2	0/3	4/1	4/0		
K(5)	4/0	3/0	1/3	3/3	6/0		
AV	96	82	13	72	96		
G4 L(4)	3/1	0/4	1/2	3/2	4/0		
M(6)	4/0	1/2	0/4	3/3	6/0		
AV	88	17	17	55	100		
O(6)	2/1	2/1	4/0	4/1	5/1		
N(6)	1/3	0/3	1/3	4/2	3/3		
P(6)	3/1	1/2	3/1	1/5	6/0		

T1: E-->A sentence paired with a true picture (P1)
T2: A-->E sentence paired with a false picture (P2)
T4: E-->A sentence paired with a false picture (P1)
T5: A-->E sentence paired with a true picture (P2)
T7: intransitive sentence paired with a true picture
(T7a.: pure intransitive)
(T7b.: pseudo-transitive)

AV: Average % of "yes" responses
(Y)/(N): adults' response under the distributive reading

(15) percentage of "yes" responses:



Group 1 (G1) and G2 have the same response pattern to the first four items; they answer "no" to all of these questions. Their behavior, however, diverges on the two types of intransitive questions: G1 answers "no" to both types of intransitives whereas G2 answers "no" to pseudo-transitives but "yes" to pure transitives. The behavior of G1 is essentially the same as that of the youngest group of children tested in the P/T experiment. The existence of G2, a group which distinguishes the two types of intransitives and treats pseudo-transitives as true transitives, also confirms a finding of P/T that implicit objects suddenly start to play a syntactic role at a stage in language development.

There is a big difference between the behavior of the first two groups and that of G3, the largest group found in the experiment. Children in G3 answer "yes" to items T1 and T7 almost 100% of the time. They also give a moderately high percentage of "yes" responses (72%) to T5. The previous experiments would have classified this group as having a close to adult competence. But their responses to T2, a new test item introduced in this experiment, reveal that they have not yet reached the adult stage; they answer positively to the false A-->E questions.

G4 gives adult responses to T1, T2, T4, and T7 but still has some trouble with T5. This is similar to the pattern of responses found in the second Japanese experiment reported in Takahashi (1990).

There were three children (O(6), N(6), and P(6)) whose responses patterns could not be classified with any of the groups identified above.

A question may be raised about the method used in grouping the children. We had no independent criteria for the classification other than the pattern of responses exhibited by the experimental results. Given the small number of trials allotted to each test item, would we not have find similar groupings even if children were answering the questions randomly? We believe that this is not true. We found only six distinct response patterns out of the thirty-two possibilities, three of which are shared by a significant proportion of children who were tested. Of course, such a treatment of the data is justified only if we can find a plausible linguistic explanation for the existence of each group. That is what we will attempt to do in the next section.

3. Discussion

3.1 Group 1

How could we explain the behavior of children in G1? One possibility is that they are adopting the 'group' reading for the NPs in the sentence. That is, whenever there is a transitive sentence containing the quantifier "every", children require that all the referents of the subject NP and all the referents of the object NP participate as a group in the action or event expressed by the verb. This explains their rejection of transitive sentences paired with asymmetric pictures (T1, T2, T4, and T5) and their acceptance of transitive sentences paired with symmetric pictures (T9 - T12). T1, for instance is rejected because there are two apples which are not participating in the event of apple eating by pigs. This idea, however, fails to explain why the children also reject the intransitive sentences paired with true pictures (T7). In T7, there is only one NP. All the referents of the NP (boys) are participating in the action expressed by the verb (sitting). Why should it matter that there are objects (chairs) in the picture not participating in the action?

What about the idea that children systematically put the wrong NP in the restrictive clause of the logical representation of sentences containing "every"?[6] Children's representation of E-->A and A-->E sentence, then, would be as in (16a. and b.) respectively.

(16)a. Every pig is eating an apple.

quantifier restrictive clause nuclear scope
$\forall$ y, apple(y), $\exists$ x[pig(x) $\wedge$ eating(x,y)]
For every apple, there exists some pig that is eating it.

b. A pig is eating every apple.

$\forall$ x, pig(x), $\exists$ y[apple(y) $\wedge$ eating(x,y)]
For every pig, there exists some apple that it is eating.

This idea explains the rejection of true transitives (T1 and T5). But aside from being implausible (Why should there be a stage when children do exactly the opposite thing from the adults?), it fails to explain the rejection of false transitives (T2 and T4), the rejection of true intransitives (T7), and the acceptance of the false "every"-->"every" sentence (T9).

What about the idea that G1 children are using the following logical representation in interpreting the sentences?

(17) Every X is Ving (a Y).
An X is Ving every Y.

$$\forall z, \left\{\begin{array}{l}\text{action expressed}\\ \text{by the verb (z)}\end{array}\right\}, \exists x, \exists y[X(x) \wedge Y(y) \wedge z(x,y)]$$

This idea works well for pictures in which all the agents are performing the same action. T1, for example, would be rejected because not every action of "eating" is the eating of an apple by a pig. All the pictures shown thus far are of this type. But the experiment also included pictures in which there are more than one action.

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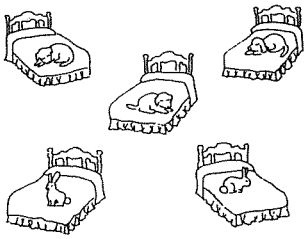
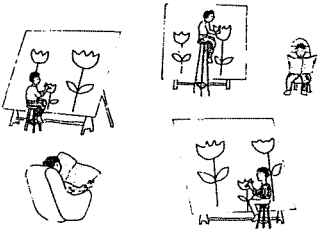
6. See P/A and P/T for proposals based on similar ideas. See Lewis (1975) and Heim (1982) for motivations behind the tripartite structure used in (16) for expressing the logical representations of sentences containing quantifiers.

(18)a. b.



T7: Is every dog sleeping?



T4: Is every man painting a picture?

If (17) correctly represents children's interpretation of the sentences, examples in (18) should be accepted. In (18a.), every action of "sleeping" is the sleeping of a dog. In (18b.), every action of "painting" is the painting of a picture by a man, satisfying (17). G1 children, however, rejected items paired with this type of pictures as well. We must, therefore, give up on this idea.

Now, consider the following representation:

(18) Every X is Ving (a Y).
An X is Ving every Y.

$$\forall e, \left\{\begin{array}{l}\text{sub-event depicted}\\ \text{in the picture (e)}\end{array}\right\}, \exists x, \exists y[X(x) \wedge Y(y) \wedge \text{Ving}(x,y,e)]$$

In (18), the quantifier binds a variable ranging over the sub-events depicted in the picture. In P1, for example, there are five such events, three eatings of an apple by a pig and two eatings of an apple by an alligator. T1 and T2 are rejected because not every sub-event dipicted in P1 is the eating of an apple by a pig. This proposal accounts for the response pattern characterizing G1; rejection of test items paired with asymmetric pictures and acceptance of those paired with symmetric pictures. Suppose that (18) is the correct representation of the children's interpretation of "every" at this stage. The next question is why (18)?

In adult grammar, "every" functions syntactically as a determiner and its quantificational force is restricted to the NP which it is a part of; it binds only the variable that ranges over the possible referents of the NP. Although children in G1 seem to

know the basic meaning of "every" that it expresses universal quantification, they allow it to bind a variable that originates outside of its NP. It may be said, then, that G1 children are treating "every" as an adverb not attached to any specific NP in the sentence.[7,8]

G1 children passed the "three"-test. Under our proposal, this means that these children are correctly treating "three" as a determiner. Whatever the reason for the misanalysis of "every", then, it cannot be attributed to the unavailability of the determiner position.

Could it be possible that children are forced to treat "every" as an adverb because they are for some reason incapable of quantifying variables ranging over individuals, which is required by the determiner analysis? We believe that this is not true. In searching the spontaneous utterances of Adam, Eve, and Sarah in the CHILDES database[9], we find almost no use of "every" in isolation. There are, however, some uses of "everybody" and "everything", which should require quantification of individual variables in the adult interpretation. We cannot find any indication that their interpretation of these words are any different from that of adults'.

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7. See Lewis (1975) for cases in which adverbs of quantification can be interpreted to be quantifying over events.

8. This analysis raises a question about the appropriateness of our first warm up question ((12) WU1). (18) predicts WU1 to be rejected because there are five sub-events dipicted in the picture, only three of which is flying of boys. Since children were given only one WU1 at the beginning of each session and were guided to answer "yes" to the question, we cannot judge what their true interpretation of the item was. Since this is an important test for (18), we must include it as a core test item in the next experiment.

9. Child Language Data Exchange System. *Cf.* MacWhinney & Snow (1985), and Brown (1973).

(19)a. just like you [...] just like [...] I break everything.
(Adam: age 3 years-5 months, file 30, line 265)

b. I can do it too. Paul can do it too. Robin can do it too. and everybody can do it too.
(Adam: age 3-5, file 31, line 840)

c. everybody don't like the fan. no [#] people don't like the fan.
(Eve: age 2-1, file 16, line 746)

d. I washed [#] for Mama my dish and and my spoon and cup and everything.
(Eve: age 2-2, file 17, line 1819)

e. this is salad roll. I going put everything on there. (Sarah: age 3-6, file 66, line 514)

f. oh [#] everybody asleep by me. (*ibid*. line. 252)

We will maintain, therefore, that the misanalysis of the syntactic category of "every" leads to the adoption of (18), not the other way around.

3.2 Group 2

Let us go on to G2. Children in this group give different responses to true intransitives and pseudo-transitives. We will follow P/T in assuming that they are treating pseudo-transitives as transitives, with a syntactically active implicit object. The pattern of responses given by G2, then, is "no" to transitive sentences paired with asymmetric pictures (T1, T2, T4, T5, and pseudo-transitive T7), "yes" to transitive sentences paired with symmetric pictures (T9 - T12), and "yes" to pure intransitives paired with true pictures (pure-intransitive T7).

Descriptively, the group reading idea accounts for the response pattern of the G2 children. (Remember that the only problem it had for G1 was the "no" responses to the true intransitives.) But it fails to explain why some children should adopt the group reading while others adopt the distributive reading, and why the emergence of the implicit object should coincide with the adoption of the group reading.

Instead, we propose the following logical representation for children in G2:[10]

(20) Every X is Ving (a Y).
An X is Ving every Y.

$$\forall\ e,\ \left\{\begin{array}{l}\text{sub-event depicted in the picture(e) and}\\ \text{involves a referent of an NP in the sentence(e)}\end{array}\right\},$$
$$\exists\ x, \exists\ y[X(x) \wedge Y(y) \wedge \text{Ving}(x,y,e)]$$

(20) and (18) predict the same response pattern to the transitive test items. Their predictions, however, diverge on pure intransitive sentences paired with true (but asymmetric) pictures. Consider "Is every boy sitting?" (T7) paired with P3. Under (20), the only relevant sub-events in P3 are the sittings of a boy on a chair. A "yes" response is expected because in every relevant sub-event, it is true that a boy is sitting. Since the only difference between G1 and G2 are their response to the pure intransitives, (20) would do well to account for the response pattern of children in G2.

Does (20) fare better than the group reading idea in explaining the difference between G1 and G2? We believe it does. G1-(18) and G2-(20) are similar in that they treat "every" as an adverb quantifying over events. They differ in the choice of the restrictive clause. The restrictive clause in (18), in a sense, is what is minimally necessary for evaluating the truth of a sentence with respect to the situation depicted in a picture. The restrictive clause in (20) is a little richer than that in (18), reflecting the content of the sentence. It is not unnatural to think that children's linguistic competence develops in this direction, and that the development in this area coincides with a development in another area, the emergence of implicit objects in the grammar.

3.3 Group 3

Now let us examine G3. G3 children give adult responses to E-->A sentences, non-adult responses to A-->E sentences. Since there is no reason to believe otherwise, we will assume that they have the adult interpretation for E-->A sentences; they have learned that "every" is a determiner. Then, why can't they give adult responses to A-->E sentences? In trying to answer this question, it is important to remember that

10. See Philip (1991) for a similar proposal.

the wide scope reading of "every" in A-->E sentences is difficult for adult English speakers as well. Some speakers do not allow this reading at all.

This indicates that a special rule (call it Rule X) is required for the wide scope reading of "every" over an indefinite subject in addition of the knowledge that "every" functions as a determiner. If children in G3 have not yet learned Rule X, it can be explained why they can give an adult responses to E-->A sentences but not to A-->E sentences. The remaining question is how children interpret A-->E sentences in the absence of Rule X.

We suggest that in interpreting A-->E sentences, G3 children fall back on their earlier strategy, that of treating "every" as an adverb. However, they are already past the stage in which an adverb can only quantify over events. They allow it to bind individual variables originating in the subject position as well as the object position. Consider some of the possible interpretations of the adverb "always" in adult grammar:

(21)a. A dog always chases a car (if it sees one).
$\forall$ x, dog(x), $\exists$ y[car(y) $\wedge$ chase(x,y)]
"It is true of every dog that it chases a car."
($\fallingdotseq$ Every dog chases a car.)

b. A cat always frightens a mouse.
$\forall$ y, mouse(y), $\exists$ x[cat(x) $\wedge$ frighten(x,y)]
"It is true of every mouse that it is frightened by a cat."
($\fallingdotseq$ A cat frightens every mouse.)

As an adverb, "always" is not attached to any specific NP in the sentence. But it can quantify variables ranging over possible referents of the subject NP as in (21a.), or the object NP as in (21b.). The choice between these two readings is determined by the content of the sentence as well as the context in which it is used.[11] If G3 children treat "every" as an adverb in A-->E sentences and if both (21a.) and (21b.) are possible interpretations for them, they could answer "yes" to T2 by using (21a.) and "yes" to T4 by using

11. The interpretation given in (21b.) seems to be easier with "frighten"-type experiencer predicates.

(21b.).[12] This would explain the response pattern of G3 children.

This proposal implies the existence of a stage in which the adverbial interpretation is used for both E-->A and A-->E sentences. This stage would be characterized by "yes" responses to every core test item ("yes" to T1, T2, and T7 by (21a.), "yes" to T4 and T6 by (21b.)). Child O(6) may be at this stage.

3.4 Group 4 and summary

Finally, let us look at G4. G4 children give adult responses to T2 (A-->E sentence paired with a false picture) as well as to the E-->A sentences. This seems to indicate the mastery of Rule X. These children, however, answer "no" to T5 (A-->E sentence paired with a true picture) 50% of the time . They still answer "yes" to T9. We do not have the explanations for these responses at this point.

The developmental stages we have proposed in this section is summarized in (22).

(22) Stage 1 (G1):
(i) "every" interpreted as an adverb quantifying over events
(ii) minimal restrictive clause

Stage 2 (G2):
(i) "every" interpreted as an adverb quantifying over events
(ii) restrictive clause reflecting sentential content

Stage 3 (O(6)?):
(i) "every" interpreted as an adverb quantifying over individual variables
(ii) either the subject or the object in the restrictive clause

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12. We are assuming that if a sentence has multiple interpretations and if there is one reading under which the picture is true, children would accept the picture as a correct description of the sentence. This assumption is supported by the fact that children who understand the non-distributive reading of "every" have no trouble accepting picture-question pairs under the distributive reading of "every".

Stage 4 (G3):
(i) "every" interpreted as a determiner in E-->A sentences
(ii) "every" interpreted as an adverb quantifying over individual variables in A-->E sentences

Stage 5 (G4):
(i) "every" interpreted as determiner both in E-->A and A-->E sentences.
(ii) non-adult behavior persists in T5 and T9 reasons not clear

5. Conclusion

The results of the new experiment provide further support for the claim that there are linguistic explanations for quantifier spreading.

We proposed that children misanalyse the category of "every" and treat it as an adverb rather than a specifier at an early stage of language development. We also proposed developmental changes in the choice of the variable bound by the quantifier and selection of elements in the restrictive clause, but they are both within the possibilities allowed by the UG.

APPENDIX 1

Summary of test items

	Picture type	Test item	Question	Adult response	# of trials GroupA	B
P1	O O O O O | | | S S S	T1	Is every S Ving an O?	Y	4	4
		T2	Is an S Ving every O?	N	4	3
		T3	Are three Ss Ving an O?	Y	2	2
P2	O O O | | | S S S S S	T4	Is every S Ving an O?	N	4	4
		T5	Is an S Ving every O?	Y	5	6
		T6	Are three Ss Ving an O?	Y	2	2
P3	X X X X X | | | S S S	T7	Is every S Ving?	Y	4	6
P4	X X X | | | S S S S S	T8	Is every S Ving?	N	4	4
P5	O O O | | | S S S	T9	Is every S Ving every O?	N	2	2
P6	O O O S S S	T10	Is every S Ving every O?	Y	2	2
P5	O O O | | | S S S	T11	Is every S Ving an O?	Y	2	2
		T12	Is an S Ving every O?	Y	2	2
P7	O O O S S S	T13	Is every S Ving an O?	N	2	2
		T14	Is an S Ving every O?	N	2	2
P8	O S S S	T15	Is every S Ving an O?	Y	2	2
P9	O O O S S S	T16	Is every S Ving a O?	N	2	2
		T17	Is an S Ving every O?	Y	1	1
P10	O O O S	T18	Is an S Ving every O?	N	2	2

APPENDIX 2

Results of the experiment: Group A

S: session, T: test item
Y/N: firm "yes"/"no", y/n: "yes"/"no" with hesitation
Y: spontaneous correction from "yes" to "no"
N: spontaneous correction from "no" to "yes"

Child:	B	F	G	J	Q	R	L	C	H	A	S		
Age:	4	4	4	4	4	4	4	4	3	3			
T1	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	S1-3	Is every boy driving a car?
T7	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	1-4	Is every dog sleeping?
T4	N	Y	Y	N	Y	Y	N	Y	Y	N		1-5	Is every man reading a newspaper?
T15	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	1-6	Is every dog holding a balloon?
T8	N	N	N	N	N	N	N	N	N	N	N	1-7	Is every girl sitting?
T6	Y	y	Y	Y	N	Y	Y	Y	Y	N		1-8	Are three girls riding a bike?
T5	Y	y	Y	Y	N	N	Y	N	Y	N	N	1-9	Is a cat climbing every ladder?
T18	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	y	1-10	Is a man pulling every rock?
T2	N	Y	Y	Y	N	N	N	N	Y	N	N	1-11	Is a boy riding every horse?
T17	N	Y	Y	/	N	N	Y	Y	N	N	N	1-12	Is a boy flying every kite?
T10	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	n	1-13	Is every girl holding every balloon?
T8	N	N	N	N	N	N	N	N	N	N	N	1-14	Is every frog swimming?
T1	N	Y	Y	Y	N	Y	N	N	Y	N	N	1-15	Is every pig eating an apple?
T7	N	N	Y	Y	N	N	Y	N	Y	N	N	1-16	Is every girl reading?
T16	N	N	N	N	N	N	Y	N	N	N	N	1-17	Is every elephant pulling a tree?
T3	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	1-18	Are three dogs holing a stick?
T14	N	Y	N	N	N	N	N	N	N	N	N	1-19	Is a man pushing every tree?
T5	N	Y	Y	Y	N	N	Y	N	Y	N	N	1-20	Is a girl drawing every picture?
T12	Y	Y	Y	N	Y	Y	Y	/	Y	Y	Y	1-21	Is a horse eating every carrot?
T2	N	Y	Y	Y	N	N	N	N	Y	N	N	1-22	Is an elephant pushing every tree?
T9	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	1-23	Is every boy holding every balloon?
T11	n	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	1-24	Is every boy pulling a boat?
T4	N	N	N	N	N	N	N	N	Y	N	N	1-25	Is every man rowing a boat?
T13	N	Y	Y	N	N	N	N	N	Y	N	/	1-26	Is every girl holding a balloon?
T1	N	Y	Y	Y	N	N	Y	N	Y	N	N	S2-3	Is every cat climbing a tree?
T7	N	Y	Y	Y	N	N	Y	N	Y	N	N	2-4	Is every boy sitting?
T4	N	N	N	n	N	N	N	N	N	N	N	2-5	Is every man painting a picture?
T13	N	Y	Y	Y	Y	N	N	N	N	N	N	2-6	Is every elephant pushing a rock?
T8	N	N	N	N	Y	N	N	N	N	N	N	2-7	Is every cat sleeping?
T3	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	n	2-8	Are three elephants eating a banana?
T18	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	2-9	Is a boy flying every kite?
T5	N	N	Y	N	N	N	N	N	Y	N	N	2-10	Is a dog eating every bone?
T2	N	Y	Y	N	N	N	N	N	Y	N	N	2-11	Is a man climbing every tree?
T12	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	2-12	Is a girl holding every basket?
T9	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	2-13	Is every man pulling every rock?
T8	N	N	N	N	N	N	N	N	Y	N	N	2-14	Is every man climbing?
T11	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	2-15	Is every boy riding a horse?
T1	N	Y	Y	Y	N	N	Y	N	Y	N	N	2-16	Is every man reading a newspaper?
T7	N	Y	Y	Y	Y	N	Y	N	Y	N	N	2-17	Is every man driving?
T6	Y	Y	Y	Y	N	N	Y	N	Y	N	N	2-18	Are three girls pulling a boat?
T2	N	Y	Y	N	N	N	N	N	N	N	N	2-19	Is a boy rowing every boat?
T5	N	Y	Y	N	N	y	Y	N	N	N	N	2-20	Is a cat pulling every string?
T14	N	Y	Y	Y	N	N	Y	N	Y	N	N	2-21	Is a girl holding every balloon?
T5	N	y	N	N	N	N	N	N	N	N	N	2-22	Is a boy pushing every wheel-barrel?
T10	n	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	2-23	Is every elephant pulling every tree?
T4	N	N	N	N	N	Y	N	N	N	N	N	2-24	Is every girl riding an elephant?
T15	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	2-25	Is every man pushing a car?
T16	N	N	N	N	N	N	N	N	N	N	N	2-26	Is every girl holding a balloon?

Results of the experiment: Group B

Child:	M	O	N	E	P	D	T	K	I		
Age:	6	6	6	6	6	4	4	5	4		
T1	Y	Y	Y	Y	Y	Y	Y	Y	Y	S1-3	Is every pig eating an apple?
T19	Y	Y	Y	Y	Y	Y	Y	Y	Y	1-4	Is every boy driving?
T5	Y	Y	Y	N	Y	N	N	Y	Y	1-5	Is a boy riding every horse?
T13	Y	Y	N	N	Y	N	Y	Y	Y	1-6	Is every girl holding a balloon?
T8	N	N	N	N	N	N	N	N	N	1-7	Is every frog swimming?
T11	Y	Y	Y	Y	Y	Y	N	Y	Y	1-8	Is every boy pulling a boat?
T3	Y	Y	Y	Y	Y	Y	N	Y	Y	1-9	Are three girls riding a bike?
T2	N	Y	N	N	N	N	N	Y	Y	1-10	Is an elephant pushing every tree?
T8	N	N	N	N	N	N	N	N	N	1-11	Is every girl sitting?
T18	Y	Y	Y	Y	Y	Y	Y	Y	Y	1-12	Is a man pulling every rock?
T4	N	N	N	Y	N	N	Y	N	Y	1-13	Is every man rowing a boat?
T7	Y	Y	N	N	Y	N	Y	Y	Y	1-14	Is every man climbing?
T6	Y	Y	Y	Y	Y	Y	Y	Y	Y	1-15	Are three dogs holding a stick?
T12	Y	Y	Y	Y	Y	Y	Y	Y	Y	1-16	Is a horse eating every carrot?
T1	Y	N	N	N	N	Y	N	Y	y	1-18	Is every boy driving a car?
T14	N	N	N	N	N	N	Y	N	Y	1-19	Is a man pushing every tree?
T7	Y	Y	N	N	Y	N	Y	Y	Y	1-20	Is every girl reading?
T16	N	N	Y	N	N	Y	Y	N	N	1-21	Is every elephant pulling a tree?
T5	Y	N	N	N	N	N	Y	N	Y	1-22	Is a girl drawing every picture?
T7	Y	Y	N	Y	Y	Y	Y	Y	Y	1-23	Is every dog sleeping?
T4	N	N	N	N	N	n	Y	N	Y	1-24	Is every man reading a newspaper?
T17	N	Y	N	N	N	N	N	N	Y	1-25	Is a boy flying every kite?
T10	Y	Y	Y	Y	Y	Y	Y	Y	Y	1-26	Is every girl holding every balloon?
T15	Y	Y	N	Y	Y	Y	Y	Y	Y	1-27	Is every dog holding a balloon?
T5	Y	N	N	N	N	N	Y	N	Y	1-28	Is a cat climbing every ladder?
T9	Y	Y	Y	Y	Y	Y	Y	Y	Y	1-29	Is every boy holding every balloon?
T10	Y	Y	Y	Y	Y	Y	Y	Y	Y	S2-3	Is every boy pulling every rock?
T5	Y	N	Y	N	N	N	N	Y	Y	2-4	Is a dog eating every bone?
T7	Y	N	Y	N	Y	N	N	Y	Y	2-5	Is every boy driving?
T16	N	N	N	N	N	N	N	N	y	2-6	Is every girl holding a balloon?
T1	Y	N	N	N	Y	N	N	Y	Y	2-7	Is every man reading a newspaper?
T12	Y	Y	Y	Y	Y	Y	Y	Y	Y	2-8	Is a girl holding every basket?
T8	N	N	N	N	N	N	N	N	Y	2-9	Is every cat sleeping?
T3	Y	Y	Y	N	Y	Y	Y	Y	Y	2-10	Are three elephants eating a banana?
T15	Y	Y	Y	Y	Y	Y	n	Y	Y	2-11	Is every man pushing a car?
T4	N	N	Y	N	Y	N	N	Y	y	2-12	Is every girl riding an elephant?
T18	Y	Y	Y	Y	Y	Y	N	Y	y	2-13	Is a boy flying every kite?
T7	Y	Y	Y	Y	Y	Y	N	Y	Y	2-14	Is every frog jumping?
T5	N	N	Y	N	N	N	N	N	N	2-15	Is a cat pulling every string?
T11	Y	Y	Y	Y	Y	Y	Y	Y	Y	2-16	Is every boy riding a horse?
T5	N	N	Y	N	N	N	N	Y	N	2-17	Is a boy pushing every wheel-barrel?
T8	N	N	Y	N	N	N	N	N	N	2-18	Is every girl drawing a picture?
T13	Y	Y	N	N	Y	Y	Y	Y	Y	2-19	Is every elephant pushing a rock?
T2	N	N	N	Y	N	N	N	Y	Y	2-20	Is a man driving every truck?
T7	Y	Y	Y	Y	Y	Y	N	Y	Y	2-21	Is every boy sitting?
T6	Y	Y	N	Y	Y	N	N	Y	Y	2-22	Are three girls pulling a boat?
T1	Y	Y	N	N	Y	N	N	Y	Y	2-23	Is every cat climbing a tree?
T19	Y	Y	Y	Y	Y	Y	Y	Y	Y	2-24	Is every man flying?
T14	Y	Y	N	N	Y	N	N	Y	Y	2-25	Is a girl holding every balloon?
T4	Y	N	N	N	N	N	N	N	N	2-26	Is every man drawing a picture?
T9	Y	Y	Y	Y	Y	Y	Y	Y	Y	2-27	Is every elephant pulling every rock?
T2	Y	Y	N	N	Y	N	N	Y	N	2-28	Is a boy rowing every boat?
T8	N	N	N	N	Y	N	N	N	N	2-29	Is every man climbing?

REFERENCES

Brown, Roger 1973. *A First Language*, Harvard University Press, Cambridge, MA.

Donaldson, Margaret & Peter Lloyd 1974. 'Sentences and situations: children's judgments of match and mismatch,' in *Problémes Actuels en Psycholinguistique.* Centre National de la Recherche Scientifique, Paris.

Heim, Irene 1982. *Semantics of Definite and Indefinite Noun Phrases*, UMass Ph.D. dissertation, GLSA, Amherst.

Inhelder, Barbel & Jean Piaget 1964. *The Early Growth of Logic in the Child*, Harper & Row, New York.

Johnson-Laird, Phillip 1983. *Mental Models: Towards a Cognitive Science of Language, Inference, and Consciousness*, Harvard University Press, Cambridge, MA.

Lewis, David 1975. "Adverbs of quantification," in *Formal Semantics of Natural Language*.

MacWhinney, Brian & Catherine Snow 1985. "The child language data exchange system," in *Journal of Child Language* 12.

Philip, Bill 1991. "Event quantification in the acquisition of universal quatifiers," ms. UMass, Amherst.

Takahashi, Mari 1990. "Children's interpretation of sentences containing dono," ms. UMass, Amherst.